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A SUMMARY OF THE FOUNDATION RESEARCH PROGRAM.(U)
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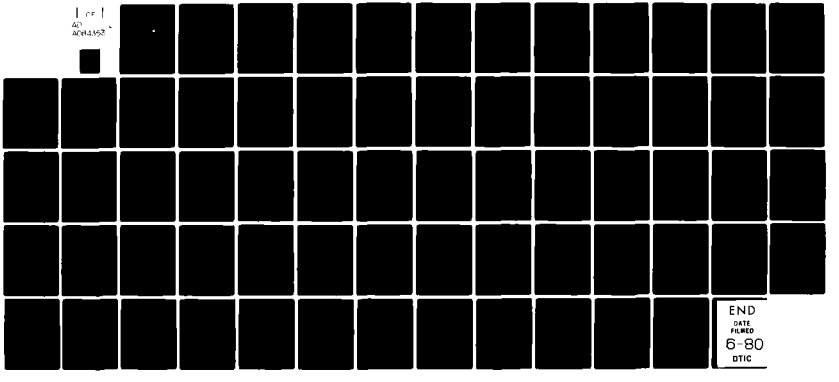

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NAVAL POSTGRADUATE SCHOOL

Monterey, California

A SUMMARY OF THE

FOUNDATION RESEARCH PROGRAM

March 1980

Report for the Period

1 October 1978 to 30 September 1979

Approved for public release; distribution unlimited

Prepared for:
Chief of Naval Research
Arlington, Virginia 22217 and
Chief of Naval Development
Washington, D. C. 20360

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

Rear Admiral John J. Ekelund

Jack R. Borsting
Provost

The work reported herein was supported by the Chief of Naval Research, Arlington, Virginia 22217 and the Chief of Naval Development, Washington, D.C. 20360.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Forty-one projects of Independent Research/Independent Exploratory Development work were carried out under funding to the Naval Postgraduate School Foundation Research Program. This research was carried out in the areas of Computer Science, Mathematics, Administrative Sciences, Operations Research, National Security Affairs, Physics and Chemistry, Electrical Engineering, Meteorology, Aeronautics, Oceanography, and Mechanical Engineering. A tabulation in Appendix I identifies area of research and the principal investigator. The category of independent research or independent exploratory research is also identified for each research task.

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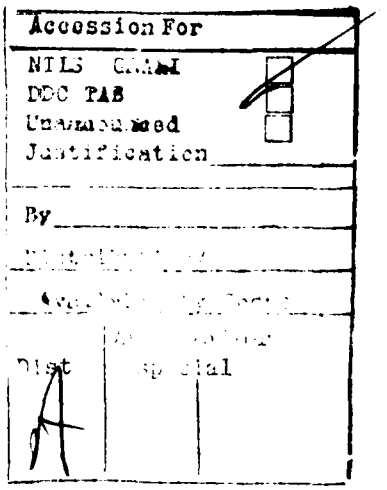

FY 1979 FOUNDATION RESEARCH

I. Introduction

The principal thrust of the research and exploratory development program at the Naval Postgraduate School (NPS) stems from its mission:

> To conduct and direct advanced education of commissioned officers, and to provide such other technical and professional instruction as may be prescribed to meet the needs of the Naval Service; and in support of the foregoing to foster and encourage a program of research in order to sustain academic excellence.

In fulfillment of the research and development program objectives and within the above constraints, the Naval Postgraduate School

> Initiates and conducts scientific and applied research (6.1) of a long-range nature in areas of special interest to the Navy.
>
> Conducts exploratory development (6.2) deriving from scientific program areas or in other areas specifically requested by the Navy.

In addition, NPS performs scientific research and exploratory development, where uniquely qualified, for other agencies of the Department of Defense and, in defense related efforts, for other Federal Government agencies. NPS also furnishes consulting services for the Navy and, where specifically qualified, for other agencies of the Department of Defense and in defense related efforts for other Government agencies.

II. Background on the NPS Research Program

The Navy has developed the Naval Postgraduate School as an academic institution which uses university educational methods to address the special graduate education requirements of the Navy. The Superintendent of the Naval Postgraduate School is a Rear Admiral of the line of the Navy. He is supported by a dual management structure, part military and part civilian. The faculty, mostly civilian, is responsible for the academic programs and, in support of these, conducts an active research effort. The military staff specifies the educational needs of the Navy, in terms of curricula, and provides administrative logistic support.

At the Naval Postgraduate School, as in other academic institutions, the faculty is organized into departments. The department represents a resource center of faculty members with allied disciplinary specialization. Currently, the departments at the Naval Postgraduate School include Computer Science, Mathematics, Administrative Science, Operations Research, Physics and Chemistry, Electrical Engineering, Meteorology, Aeronautics, Oceanography, Mechanical Engineering, and National Security Affairs. Inter-disciplinary groups which have effective departmental status include Acoustics, Anti-Submarine Warfare, Electronic Warfare and Command, Control and Communication (C3).

Research and development projects are largely conducted by the individual and faculty members on a project basis. Projects typically originate from proposals prepared either by individual faculty members, or by groups of faculty members from the same or different departments.

The research program is divided administratively into two parts. First is the Sponsored Research Program. This program includes projects awarded by sponsoring agencies to an individual principal investigator. The principal source of funds is the various commands and laboratories of the Naval Material Command. The sponsored program constitutes about 80% of the total NPS research program. The Foundation Research Program is based on a grant from the Chief of Naval Research and the Chief of Naval Development. This program is administered internally by a Research Council. The Council meets periodically to review faculty proposals, allocate fundings, and review results of completed projects.

Appendix I identifies each project by title and category or type funding (Basic Research - 6.1 and Exploratory Development - 6.2). The 6.1 category was funded by the Chief of Naval Research, Arlington, Virginia 22217 and the 6.2 category was funded by the Chief of Naval Development, Washington, D.C. 20360.

This report summarizes the FY 1979 Foundation Research Program.

Title:	A Microprocessor Based Secure Archival Storage System
Investigators:	Lyle A. Cox, Jr., Assistant Professor of Computer Science and Roger R. Schell, LTCOL, USAF, Assistant Professor of Computer Science
Sponsor:	NPS Foundation Research Program
Objective:	Specify, design and implement a certifiably secure archival storage system based on microprocessor technology. Such a system can serve as the "hub" of a secure network of computers sharing data and programs.
Summary:	Security has been a continuing problem in developing and operating all types of computers, especially distributed networks of computers. Since these systems have the potential of allowing a wide audience of users to access sensitive data, they must be designed with caution. A technique for such system design, the "kernel technique," has been shown to be capable of providing the necessary security. Until recently, this technique could be implemented efficiently only on large computers. Recent advances in large scale integration microprocessors and "Winchester" disk storage systems have made it possible to implement a secure archival system on a mini/micro scale. This scale is required for development of reliable distributed processing systems such as the "automated office" and the Navy's "SNAP II" systems. Specifications, basic and advanced designs for this system have been completed and the project is entering early stages of implementation.
Theses Directed:	E. J. Parks, "Operating System for Secure Multi-level Data Storage and Retrieval," in-progress. D. L. Smith, "Method to Evaluate Microcomputers for Non-Tactical Shipboard Use," Master's Thesis, September 1979.

A. R. Coleman, "Security Kernel Design for a Microprocessor-Based, Multilevel, Archival Storage System," Master's Thesis, September, 1979.

Title:	A Decision Support System Model for Technology Transfer
Investigator:	Ronald J. Roland, Instructor of Computer Science
Sponsor:	NPS Foundation Research Program
Objective:	To develop a conceptual model of the DSS design process; select and adapt, or create, appropriate software to mechanize the model; develop a knowledge base to describe the interactiveness of various organization variables and managerial decision-making needs.
Summary:	Technology transfer is the process by which technology originating at one institutional setting is adapted for use in another. A major impediment to the implementation of new technologies to assist with managerial decision-making problems, is a lack of communication between the technology and management communities. Development of a tool designed to bridge the technology transfer gap is the goal of this research. The result will be a prototype software package which may be used on an interactive computer terminal by a manager for assistance in designing a decision support system (DSS).
Publication:	Ronald J. Roland, "A Decision Support System Model for Technology Transfer," November, 1979. NPS52-79-002 (in preparation).

Title:	Comparison of Methods for Approximation of Surfaces by Interpolation at Scattered Data Points
Investigator:	R. Franke, Associate Professor, Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	The objective is a critical comparison of proposed methods for fitting surfaces to scattered data by interpolation.
Summary:	A total of 29 programs for scattered data interpolation were written or obtained from their authors. These were compared on a number of sets of data, consisting of both test surfaces and data for which the underlying surface is unknown. Tables of accuracy, timing, sensitivity to parameters and other aspects were generated. Plots of surfaces were obtained for visual purposes.
Publications:	A technical report, "A Critical Comparison of Some Methods for Interpolation of Scattered Data," NPS-53-79-003, is nearing completion. A manuscript, "Smooth Interpolation of Large Sets of Scattered Data," (joint with G. M. Nielson) has been prepared to submit for publication. A manuscript, summarizing the results of the project and pointing towards NPS-53-79-003, will be prepared and submitted for publication.

Title:	Convergence of the Conjugate Gram Schmidt Method
Investigator:	I. Bert Russak, Associate Professor of Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	To determine the convergence characteristics of the conjugate Gram Schmidt method (described below) in the nonquadratic case when using numerical derivatives.
Summary:	Problems in optimizing functions occur very frequently in military applications, e.g., optimizing with respect to time to intercept, the parameters of a missile interceptor system. Furthermore, since constrained optimization problems can often be stated in terms of unconstrained ones, then methods for solving the latter are very important. The conjugate Gram Schmidt method is a powerful tool for solving unconstrained optimization problems and understanding its convergence characteristics is necessary for its successful application to actual problems. We note that: i) the conjugate Gram Schmidt method, as originally devised, uses first and second derivatives which generally require a large amount of computer time to evaluate. However, the version of the method herein considered replaces analytic derivatives by numerical differences, yielding a significant reduction in computer time; ii) application of the method in the nonquadratic case requires a sequence of cycles, with each cycle determining the starting point of the next cycle.
Publications:	Russak, I. B., Convergence of the Conjugate Gram Schmidt Method, accepted for publication in the Journal of Optimization Theory and Applications.

Title:	Workshop on Applied Mathematics
Investigators:	Arthur L. Schoenstadt, Associate Professor of Mathematics and Craig Comstock, Professor of Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	Numerous observers of current mathematics have perceived an "information gap" between what is oftened labeled "applied mathematics" and the mathematics actually used in applications in industry and government laboratories. The objective of this workshop was to provide a forum, building on the theme of linear systems, to help narrow this gap.
Summary:	The workshop was held at the Naval Postgraduate School, 20 - 24 February, 1979, and consisted of three sessions of invited papers, as well as contributed paper sessions. In each of the invited paper sessions, two outstanding workers, one an applied mathematician and the other an engineer, started by speaking jointly on a common topic of interest in the area of linear systems. The engineer presented his problems, techniques, constraints, difficulties and trends, while the mathematician presented recent developments which have proven useful or seem to show promise. These presentations were followed by an in-depth discussion between the presenters and members of the audience. Approximately 80 engineers and mathematicians attended and, in addition to the six invited presentations, approximately 20 contributed papers were presented.
Publications:	Proceedings in preparation.

Title:	An Analysis of the Relationship of Performance to Perceived Control over Budget Measures Used for Evaluative Purposes
Investigator:	Kenneth J. Euske, Assistant Professor of Accounting
Sponsor:	NPS Foundation Research Program
Objective:	To investigate the relationship of performance as measured by the operating budget and the perceived ability of the manager to control the budget measures used for performance evaluation.
Summary:	The field research project investigated the relationship of performance as measured by the operating budget and the perceived ability of the manager to control the budget measures used for performance evaluation. The data were analyzed using a linear model. The results indicate a relationship between performance as measured by the operating budget and the perceived ability of the manager to control the budget measures used for performance evaluation. However, the moderating variables of sex of the manager, leadership style of the manager's supervisor and differences between the firms participating in the study demonstrated the strongest relationships with performance as measured by the operating budget.
Publication:	Euske, K. J., Jackson, D. W., Jr., and Reif, W. E., "Exploring the Performance and Satisfaction of Bank Managers." Journal of Bank Research, in press.

Title:	Computer System Conversions: Estimating Costs and Regulatory Effects
Investigators:	C. R. Jones, Chairman, Department of Administrative Sciences and P. Ein-Dor, Adjunct Professor of Information Systems
Sponsor:	NPS Foundation Research Program
Objective:	To study the complete cost of transporting software systems from one hardware system to another, to investigate the regulatory effects of current acquisition rules when software conversion is involved and to suggest modifications to procedures which might increase agency efficiency without reducing competition.
Summary:	Data on computer system conversion costs were obtained from material made available by NAVDAC and GAO. These data permitted formulation of a model for predicting software conversion costs based on the nature and size of programs to be converted. This model is now being used to study the cost of procedures which induce conversions by mandating competitive acquisitions. Alternatives are being examined to determine whether changes in acquisition procedures may permit a reduction in the outlays on conversions without detracting from the advantages of competitive acquisition.
Publications:	Two reports are currently in preparation, one on the cost estimation model for software conversions and the other on the conversion-related aspects of acquisition procedures.

Title: Application of the Lognormal Distribution to Corrective Maintenance Downtimes

Investigators: Melvin B. Kline, Professor of Administrative Science and LCDR Ronny Almog, Israel Navy

Sponsor: NPS Research Foundation Program

Objectives: The objectives of the research were to verify that the lognormal distribution is a suitable descriptor for corrective maintenance repair times; to estimate the percentage error caused in assuming an exponential distribution for availability and maintainability calculations when, in fact, the distribution is lognormal; to test the lognormal and exponential distributions against mechanical and other nonelectronic systems, since the current data base is primarily on electronic systems; to test these distributions for systems and equipments in which new technologies in microcircuitry and computation are used to increase reliability and decrease diagnostic time; and to determine expected ranges of the principal distribution parameters for different classes of equipment.

Summary: From the data analysis conducted in this research, we conclude that the lognormal distribution is a good descriptor of the distribution of corrective maintenance repair time. Fifteen of the 19 cases from maintainability demonstrations of radically different designs tend to show that, with an acceptable level of significance, this assumption cannot be rejected. Similarly, the data analysis shows that the assumption of an exponential distribution should be rejected in 17 of the cases.

The percentage error in the MTTR, when assuming an exponential distribution instead of a lognormal distribution, as a matter of convenience, for calculating system availability has been found to be small. Other than the one case in which the exponential would not be rejected and the

lognormal would, all cases have an error less than ten percent and, thus, will not have any significant effect on availability.

We were unable to obtain maintainability demonstration data on mechanical systems or on systems using digital and microcircuit technology to a significant extent. It is hoped that future research will explore these types of systems and equipments.

Publications:

M. B. Kline and R. Almog, "Application of the Lognormal Distribution to Corrective Maintenance Downtimes," Proceedings, NATO/AGARD Conference on Avionics Reliability, its Techniques and Related Disciplines, NATO/AGARD, Neuilly Sur Seine, France (1979), pp. 3.10-1 to 3.10-13.

NPS technical report in preparation.

Conference Presentation:

M. B. Kline and R. Almog, "Application of the Lognormal Distribution to Corrective Maintenance Downtimes," NATO/AGARD Conference on Avionics Reliability, its Techniques and Related Disciplines, Ankara, Turkey, 9 - 13 April 1979.

Thesis Directed:

R. Almog, "A Study of the Application of the Lognormal Distribution to Corrective Maintenance Repair Times," Master's Thesis, June 1979.

Title:	Estimating Probabilities for Cost Variance Investigation Decisions: A Bayesian Approach
Investigator:	Shu S. Liao, Associate Professor of Accounting
Sponsor:	NPS Research Foundation Program
Objective:	Develop method to utilize the Bayesian decision theory to arrive at a decision rule that will minimize the expected total cost from investigating cost deviations.
Summary:	Some cost deviations represent random variation and, therefore, cannot be corrected. Others, however, may be caused by correctable factors and require investigative and corrective actions. This research develops a simple and easy-to-follow procedure for obtaining and updating reliable probability estimates from available cost reports, so that a decision rule can be developed to minimize total cost.
Publication:	Shu S. Liao, "Contract Cost Overrun Audit Strategy: A Bayesian Approach," under review for publication in Naval Research Logistics Quarterly.

Title:	The First Years Out Study--Career Transitions: Facilitating Recruit Adaptation
Investigator:	M. R. Louis, Assistant Professor
Sponsor:	The Research Board, The University of Illinois, Urbana-Champaign and the NPS Foundation Research Program
Objective:	This study is a part of a continuing research program, the overall aims of which are to expand our understandings of the characteristics of career transitions, and cognitive and behavioral processes by which individuals cope with transitions, organizational practices which could facilitate transitions of individuals into unfamiliar organizational settings.
Summary:	Thus far, the research program has resulted in the formulation of: a theoretical model of the cognitive processes by which individuals cope with transition experiences, a conceptual framework distinguishing among features of transition experiences, i.e., 'surprise', 'contrast', and 'change'; typology of career transition situations, to aid in analyzing particular transition situations and integrating research transition settings. Future work will aim at empirically assessing and refining each of the above.
Publications:	Career Transitions: Varieties and Commonalities. To appear in Academy of Management Review, July, 1980. Surprise and Sense-Making: What Newcomers Experience in Entering Unfamiliar Organizational Settings. To appear in Administrative Science Quarterly.
Conference Presentations:	A Framework of Redesigning Organizational Entry Practices. Presented at the ORSA/TIMS meetings, Los Angeles, California, November, 1978.

Title:	An Approach to Demand Theory Under Uncertainty
Investigator:	George Thomas, Adjunct Professor of Administrative Sciences
Sponsor:	NPS Foundation Research Program
Objective:	Development of a theory to explain demand theory under uncertainty.
Summary:	Recent articles have extended the traditional theory of the firm into a non-deterministic environment. Such extensions frequently involve the presence of a random variable in the demand function. The explicit incorporation of uncertainty into the model of the firm usually leads to a situation of demand-supply disequilibrium in the market place, e.g., expected excess demand is nonzero. The availability of the good becomes an important attribute in these markets. Such markets include public utilities, recreational parks, restaurants and airlines. This research: 1) discusses the effect of such disequilibrium on consumer behavior; 2) develops a more realistic model of consumer behavior under less than certain probability of delivery of the good; and 3) applies the model to a market pricing problem.
Publication:	Submission is in preparation.

Title:	Enhancements to LLRANDOM II Random Number Generation Package
Investigator:	Peter A. W. Lewis, Professor of Statistics and Operations Research
Sponsor:	NPS Foundation Research Program
Objective:	To investigate the latest Gamma random number generators for inclusion in the LLRANDOM II package and to finish coding the package in such a way as to facilitate use of new multipliers without new programming effort.
Summary:	The initial object of this work was to make available a fast and reliable package for generating common random variables such as normal, exponential, Cauchy, Gamma, Geometric and Poisson. The two-parameter Gamma family of random variables is particularly difficult to simulate efficiently and the new routines coded into LLRANDOM II were found to be less efficient than the routines in LLRANDOM I. Thus, a further investigation was undertaken and the enhanced LLRANDOM II package incorporates the newest and simplest Gamma variate generators, which we have shown to be a considerable improvement over previous generators. The enhanced LLRANDOM II package also has the capability of producing arrays of sorted variates (uniform, exponential, Gamma, Cauchy, etc.) and a simple way of choosing from either the old multiplier (16807) from LLRANDOM I and a new multiplier (397204094). The new multiplier significantly slows down the generation process, but generates random numbers which have better statistical properties than those generated with the old multiplier if the sequences are not shuffled.
Publications:	Two manuals for LLRANDOM II are in the final stages of preparation.

Title:	Quantitative Analysis of Air-War Strategies for Use in Air-Armaments Planning
Investigators:	James G. Taylor, Professor of Operations Research and Reiner K. Huber, Professor of Applied Systems Science, Hochschule der Bunderswehr, Munchen
Sponsor:	NPS Foundation Research Program
Objective:	To develop quantitative methodology (including computational algorithms and computer programs) for determining optimal air-war allocation strategies in long-range planning situations. In this initial phase, to formulate the attendant operational models to support this general goal. Also, to improve the scientific bases for such operational models (development of a theory of combat).
Summary:	The research program was pursued on several fronts. Feasible evaluation methodology was established by reviewing previously developed air-campaign models that internally allocate air-combat resources to missions (in particular, optimization models) and other relevant contemporary force-on-force combat models. Based on such a comprehensive review of the combat-modelling state of the art, an operational model, the Tactical Air War Analysis Game (TAWAG), was designed and steps initiated for its implementation as a computer program on a large-scale digital computer. Also, both investigators helped organize and participated in a theory-of-combat workshop, in which the scientific underpinnings of such operational combat models were critically reviewed.
Publications:	J. G. Taylor, "Attrition Modelling," Operations-analytische Spiele für die Verteidigung, R. K. Huber, K. Niemeyer and H. W. Hofmann (Editors), Oldenbourg, Munchen, pp 139-189, 1979.

J. G. Taylor, "Some Simple Victory-Prediction Conditions for Lanchester-Type Combat Between Two Homogeneous Forces with Supporting Fires," Naval Research Logistics Quarterly, 26, pp. 365-375, 1979.

R. K. Huber, L. J. Low and J. G. Taylor, "Some Thoughts on Developing a Theory of Combat," Technical Report NPS55-79-014, July, 1979.

R. K. Huber and J. G. Taylor, "On an Analytical Game to Assess Long-Range Air Armaments Policy Options (TAWAG)," in preparation.

Conference Presentation:

R. K. Huber, "Appoximating a Theory of Combat," DNA/NPS Theory of Combat Workshop, Monterey, California, 10 July 1979.

J. G. Taylor, "A Review of Some Previous Attempts to Establish a Theory of Combat," DNA/NPS Theory of Combat Workshop, Monterey, California, 10 July 1979.

Theses Directed:

C. C. Chon, "Methodology for Evaluation of Air Armaments Planning," Master's Thesis, March, 1979.

S. L. Shupack, "An Examination of the Conceptual Basis of the Attrition Processes in the Institute for Defense Analyses Ground-Air Model (IDAGAM)," Master's Thesis, March, 1979.

R. W. Szmczak, "Transferability of Combat Models: Limitations Imposed by Documentation Practices," Master's Thesis, September, 1979.

F. F. von Fabeck, "A Conceptualization of Fire Superiority for Greater Reality and Credibility of Combat Models," Master's Thesis, September, 1979.

Title:	Minimum Delay Routing of C^3 Computer Networks Using Adaptive Distributed Algorithms
Investigator:	Jin Y. Yen, Adjunct Professor of Operations Research
Sponsor:	NPS Foundation Research Program
Objective:	To develop adaptive distributed algorithms for minimizing delays in C^3 computer networks.
Summary:	The purpose of this research project was to develop efficient adaptive distributed algorithms for minimizing delay in routing C^3 computer networks. The first stage of the project developed some adaptive distributed shortest path algorithms which were used as subroutines for solving minimum delay routing in C^3 computer networks. Efficient adaptive shortest path algorithms were developed for this purpose. The advantage of these algorithms are that they are up to N time more efficient than other available algorithms, where N is the number of nodes in the network.
Publications:	Yen, Jin Y., "A decentralized algorithm for finding the shortest paths in defense communications networks," NPS55-79-015, July, 1979. Yen, Jin Y., "Distributed shortest path algorithms for computer networks," NPS55-79-017, July 1979.

Title:	Communist Countries and Africa
Investigator:	Jiri Valenta, Assistant Professor of National Security Affairs
Sponsor:	NPS Foundation Research Program
Objective:	To assemble papers and edit an anthology which would assess the military involvement of Communist countries in Africa, a subject previously discussed in Valenta's article "Soviet-Cuban Intervention in Angola, 1978," Studies in Comparative Communism, Spring-Summer 1978. To convene a three-day conference on Communist countries and Africa at the Naval Postgraduate School on July 26-28, 1979, for the presentation of invited papers by leading national and international experts on the subject.
Summary:	The conference fulfilled the stated objectives by bringing together the leading experts in this field, who delivered papers, and NPS students who are currently working on theses in this area and who helped with the organization of the conference. The principal investigator served as organizer of the conference and will be co-editor of its proceedings. Valenta wrote and presented a paper at the conference and chaired most of the conference sessions.
Publications:	Valenta, J. and Albright, D., "Communist Countries and Africa," (eds.) (Bloomington: Indiana University Press, forthcoming, 1980). Contract has been signed.) Valenta's chapter "Communist Countries and the Horn of Africa," will be included in the book.
Conference Presentations:	"Communist Countries and the Horn of Africa," NPS conference on the Communist Countries and Africa.
Theses Directed:	W. A. Nurthen, "Soviet Strategy in the Red Sea Basin," Master's Thesis, March, 1980. LCDR Shannan Butler, "East German Foreign Policy in Africa, Interaction within the Warsaw Pact," Master's Thesis, June, 1980.

Title: The USSR, Cuba and Africa

Investigator: Jiri Valenta

Sponsor: Foundation Research Program

Objective: To assess the Soviet and Cuban military intervention in Africa. This study is an outgrowth of an earlier research project on the Soviet-Cuban intervention in Angola which has been published in a scholarly journal and as part of an anthology.

Summary: The research for this paper relies extensively on Soviet, East European and African sources. The results indicate a new assertive pattern in Soviet and Cuban behavior characterized by military involvement in the Third World, in general, and in Africa in particular. The Soviet-Cuban intervention in Angola and Ethiopia came about as a trend. Other related factors were qualitative and quantitative improvement of Soviet sea--and air--lift capabilities, perfection of Soviet-Cuban military cooperation, Soviet strategic objectives in the Red Sea, accurate assessment of the U.S. response and pressures of Soviet domestic and bureaucratic politics. There is a remote likelihood that military intervention by the Soviets and Cubans (and lately the East Germans), if not countered, may be repeated in other strategically important areas of Africa: Namibia, South Rhodesia and elsewhere. This topic calls for further careful examination.

Publications: "Soviet-Cuban Intervention in Angola, 1975: Security Implications," U.S. Naval Institute Proceedings, April, 1980.

"Soviet-Cuban Intervention in Angola: Politics, Naval Power, Strategic Implications," S. Rosefielde (ed.), World Communism in Transition. (Boston: Martinus Nijhoft, May, 1980.)

Theses Directed: "East German Foreign Policy in Africa, Interaction within the Warsaw Pact," Shannan Butler, LCDR/USN, June, 1980.

Title:	The USSR and the Somalian-Ethiopian Conflict
Investigator:	Jiri Valenta, Assistant Professor and Coordinator of Soviet and East European Studies, Department of National Security Affairs
Sponsor:	NPS Foundation Research Program
Objective:	To assess the Soviet and Cuban military intervention in the Horn of Africa in 1977-1978. (This study is the outgrowth of an earlier research project on the Soviet-Cuban intervention in Angola, which has been published in a scholarly journal and as part of an anthology.)
Summary:	The research for this paper, which relies extensively on Soviet, East European and African sources, was conducted with Captain Gary McGraw who is my student. The results indicate a new assertive pattern in Soviet and Cuban behavior characterized by military involvement in the Third World, in general, and in Africa in particular. The Soviet-Cuban intervention in Ethiopia came about as a result of this trend. Other related factors were qualitative and quantitative improvement of Soviet sea--and air--lift capabilities, perfection of Soviet-Cuban military cooperation, Soviet strategic objectives in the Red Sea, accurate assessment of the U.S. response and pressures of Soviet domestic and bureaucratic politics. There is a remote likelihood that military intervention by the Soviets and Cubans (and lately the East Germans), if not countered, may be repeated in other strategically important areas of Africa: Namibia, South Rhodesia and elsewhere. This topic calls for further careful examination by experts on the subject in the form of a conference.
Publication:	"The Soviet-Cuban Military Intervention in the Horn of Africa," J. Valenta and G. McGraw in Communist Countries and Africa, Valenta, J. and Albright, D. (eds.) (Bloomington, Indiana University, 1980.)

Title:	Investigation of the LINAC Electron Beam as a Source of Coherent Electromagnetic Radiation
Investigator:	F. R. Buskirk, Professor of Physics
Sponsor:	NPS Foundation Research Program
Objective:	Theoretical investigation of the LINAC as a tool for producing coherent electromagnetic radiation to be followed by experiments.
Summary:	The research has included a historical survey of scientific developments predating the free electron laser (FEL) concept and a general theory of operation of the FEL. The use of electromagnets to generate a static periodic magnetic field of alternating polarity (as a pump wave source) was investigated. Measurements of characteristics of the proposed electromagnet design were analyzed. The results from this initial research will be used in the investigations of electromagnetic shock radiation, which has been funded by the Office of Naval Research.
Thesis Directed:	R. B. Ellis, "Stimulated Emission by Relativistic Electrons Traversing a Periodic Magnetic Field," Master's Thesis, June, 1979.

Title: Nuclear Giant Multipole Resonances by Inelastic Electron Scattering

Investigators: F. R. Buskirk, Professor of Physics, J. N. Dyer, Professor of Physics and R. Pitthan, Professor of Physics

Sponsor: Naval Postgraduate School Foundation

Objective: A survey of the collective modes of oscillation of nuclei, called giant resonances. These resonances have been observed in the energy range from 10 to 35 MeV in various medium and heavy nuclei.

Summary: Scattering experiments using the NPS LINAC included ^{238}U, ^{140}Ce, ^{89}Y, ^{60}Ni, ^{58}Ni and ^{28}Si, which combined with our previous studies of ^{208}Pb, ^{197}Au and ^{165}Ho, from a survey of the giant resonances in many nuclei. The energy resolution of about 0.4% to 0.5%, was usually sufficient for studying these broad resonances; the excitation energy range covered was from 4 to 40 or 50 MeV and showed giant resonances of energies from 6 to 33 MeV. The cerium experiment was especially productive. In addition to E2(ΔT=0) at 10 MeV and El at 15.3 MeV, the isovector E2 appears at 25 MeV and 36 MeV in general agreement with the model of Bohr and Mottelson. For Uranium, both quadrupole resonances were observed, but were low in strength unless a transition radius larger than the ground state radius was assumed.

Publications:

R. Pitthan, H. Hass, D. H. Meyer, F. R. Buskirk and J. N. Dyer, "Eo, El, E2, E3 and E4 giant resonances in the N=82 nucleus ^{140}Ce between 4 and 48 MeV excitation energy with inelastic electron scattering," Physical Review C 19, p 1251 (1979).

R. Pitthan, F. R. Buskirk, J. N Dyer, E. E. Hunter and G. Pozinsky, "Distribution of E2 strength in ^{28}Si below 50 MeV excitation energy, Physical Review C 19, p. 299 (1979).

R. Pitthan, G. M. Bates, J. S. Beachy, B. B. Dally, D. H. Dubois, J. N. Dyer, S. J. Kowalick and F. R. Buskirk, "Comparison of giant multipole resonances of multipolarity E1 to E4 in ^{58}Ni(T_o=1) and ^{60}Ni(T_o=2) with inelastic electron scattering," Physical Review C 20, (1979).

Title:	Classical Trajectory Studies of Low Energy Ion Impact Mechanisms on Clean and Reacted Single Crystal Surfaces
Investigators:	Don E. Harrison, Jr., Professor of Physics with B. J. Garrison and N. Winograd, Pennsylvania State University
Sponsors:	National Science Foundation and NPS Foundation Research Program (collaborators have separate support)
Objectives:	Continue study of the effects produced when ions bombard clean and chemically reacted single crystal metal surfaces to understand mechanisms and coordinate with experimental investigations.
Summary:	Classical trajectory simulations have developed to the point that it is feasible to model the cascade produced by an ion impact event. The ability to follow each individual atom in the cascade leads naturally to pictorial interpretations of a single sputtering event. Statistical analysis of data produces numbers which can be directly compared to the experimental data. The model computations are done using single crystal targets oriented to expose the low index surfaces. Research effort this year has been devoted to the study of the ion energy dependence of the effects previously reported. The distribution of the number of atoms ejected for single ion (ASI) tells a great deal about the formation of multimers. Most of the ejected atoms (or 90 percent) come from the first target layer at all ion energies investigated (25 eV to 20.0 KeV). The second and third layer yields peak at approximately 10 KeV for the Cu/Ar^+ system for both the (111) and (100) surfaces. Preliminary studies of ion mass dependence were begun.
Publications:	B. J. Garrison, Nicholas Einograd and Don E. Harrison, Jr., "Ejection of Molecular Clusters from Ion-Bombarded Surfaces," J. VAc. Sci. Technol., 16(2) 789-92 (1979).

N. Winograd, B. J. Garrison, T. Fleisch W. N. Deglass and D. E. Harrison, Jr., "Particle Ejection from Ion-Bombarded Clean and Reacted Single Crystals," J. Vac. Sci. Technol. 16 (2) 629 (1979).

B. J. Garrison, N. Winograd and Don E. Harrison, Jr., "Atomic and Molecular Ejection from Ion-Bombarded Reacted Single-Crystal Surfaces. Oxygen on Copper (100)," Phs. Rev. B., 18, 6000-6010 (1978).

Conference Presentations:

Don E. Harrison, Jr., Barbara J. Garrison and Nicholas Winograd, "Atom Ejection Mechanisms and Models," Proceedings of the Second Int'l SIMS Conference, Palo Alto, California, August, 1979.

D. E. Harrison, Jr., "Atom Ejection Studies by Classical Trajectory Simulation," Proceedings of the Surface Physics Workshop, La Jolla, California, August, 1979.

Don E. Harrison, Jr., "The Influence of Cascade Interactions on Sputtering by Molecular Ions," Atomic Collisions in Sounds IX, Hamilton, Ontario, Canada, 1979.

Title:	Spectroscopic Data Center Compilation of Atomic Energy Levels
Investigator:	Raymond L. Kelly, Professor of Physics
Sponsor:	NPS Foundation Research Program
Objective:	To produce a useful, comprehensive and semi-critical compilation of atomic energy levels, based on publications listing spectrum lines. The compilation is to be stored on magnetic tape, in order to be available to a large community of users and is to be updated regularly on a continuing basis.
Summary:	The initial phase of the compilation has been completed for the first 18 elements, Hydrogen through Argon, for all stages of ionization. Such information makes possible classification of unidentified lines from plasma sources and in solar spectra, as well as the prediction of other lines (valuable in laser physics).
Publication:	Ionization Potential of Fe XVII in the Neon Isoelectronic Sequence, Revised Value; by Raymond L. Kelly and Don E. Harrison, Jr., Atomic Data and Nuclear Data Tables 19, 301-303 (1977).

Title:	Forward Scatter from a Randomly Rough Surface
Investigator:	H. Medwin, Professor of Physics
Sponsor:	Naval Postgraduate School Foundation
Objective:	To calculate sound forward scattered at the sea surface.
Summary:	The Biot-Tolstoy theory of diffraction by wedges is used as a building-block for the calculation of forward at a sea surface composed of contiguous wedges. The objective of the research is to study the effects of shadowing on rough surface forward scattering. To reach this objective a computer modelling technique that was developed in the FY77 research on forward scatter has been completed to isolate the contributions due to facet reflection and facet diffraction in long-crested surfaces and the results will be compared with available experiments. To summarize, the aim of the proposed research is to reach a better understanding of rough surface forward scattering through the inclusion of shadowing and multiple scatter effects which have been shown to be necessary for both the direct and the inverse problem.
Publications:	J. C. Novarini and H. Medwin, "Diffraction, reflection and interference during near-grazing and near-normal ocean surface backscattering," J. Acoust. Soc. Am. 64, 269-268(1978).

Title: Laser Induced Acoustic Pulses in Water

Investigator: F. Schwirzke, Associate Professor of Physics and Chemistry

Sponsor: NPS Foundation Research Program

Objective: In this new project the generation of sound by laser pulses, the coupling efficiency and the sound spectrum were studied.

Summary: The interaction of Q-switched neodymium glass (1.06 μm) laser radiation with distilled water for the purpose of creating acoustic pulses was investigated. Average laser output was 80 MW. Two sound generation mechanisms were studied: thermoelastic expansion and dielectric breakdown. The thermoelastic process was shown to produce a spherically expanding pressure wave with a fundamental frequency of 50 kHz. Maximum sound pressure levels of 65 dB (re 1 μbar) were observed with an energy coupling efficiency on the order of 10^{-6}%. The frequency of 200 kHz and produce sound pressure levels near 120 dB (re 1 μbar). The coupling efficiency was approximately 1%.

Additionally, Schlieren system shadowgraphs revealed the formation of a dense plasma bubble in the breakdown region. Peak pressures within the bubble were calculated to be as high as 450 k bars. Maximum shock velocities of 8.5×10^5 cm/sec were measured from the shadowgraphs.

Theses Directed: D. A. Armstrong, "Laser Induced Acoustic Pulses in Water," Master's Thesis, December 1978.

J. H. Cocowitch, "Laser Induced Acoustic Pulses in Water," Master's Thesis, December, 1978.

Title:	Time Development of Laser Produced Plasmas
Investigators:	F. Schwirzke, Associate Professor of Physics and Chemistry
Sponsor:	NPS Foundation Research Program
Objective:	In this continuing project the interaction is investigated between intense laser pulses and targets. The dynamics of the laser produced plasma and self-generated magnetic fields are studied.
Summary:	Further experimental evidence has been found that magnetic fields are generated in the steepened front of a fast moving plasma plume which is interacting with a background plasma. A laser produced plasma expands in z-direction normal to the target surface with a velocity of about 10^7 cm/sec. If the laser produced plasma flows into a photo-ionized background plasma of sufficient density, shock heating at the front will produce a temperature gradient in z-direction. Magnetic fields in azimuthal direction are then generated long after laser shut-off by the cross product of the radial density gradient and the electron temperature gradient in z-direction. The location of the peak magnetic field coincides with the steepest gradient in the shock front. Very basically spontaneous magnetic fields should be generated whenever a shock is produced by a plasma streamer.
Conference Presentations:	F. Schwirzke and C. Y. Parlar, "Magnetic Field Generation in a Hydrogen Plasma by Laser-Produced Shock Waves," 1979 IEEE International Conference on Plasma Science, June 4-6, 1979, Montreal, Canada.
Publication:	Conference - Record Abstracts, IEEE Catalog Number 79CH 1410-0 NPS, p. 127 (1979).
Thesis Directed:	C. Parlar, "Self-Generated Magnetic Fields in Laser Produced Shock Waves," December, 1978.

Title:	Alternative Seafarer Antennas
Investigator:	O. M. Baycura, Associate Professor of Electrical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	To reduce the physical size of the present Seatores antenna from 100 miles to approximately ten miles.
Summary:	By using a magnetic antenna with high permeability ($\simeq 10^6$) and high dielectric constant ($\simeq 10$), the wave velocity can be reduced from the speed of light to 1/1000 the light speed. This speed reduction reduces the antenna to ten miles of length for one-quarter wave length radiator with high radiation resistance and efficiency.
Publications:	O. J. Baycura, "Alternative Seafarer Concepts," NPS Report No. NPS62-79-009PR, 1 January 1979.

Title:	Investigation of Transient EM Waves in Frequency-Dispersive Media by a Multiple-Scattering Method
Investigator:	Kenneth G. Gray, Assistant Professor of Electrical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	To develop a new method for solving transient electromagnetic problems.
Summary:	This research involves a new method for finding the transient response of frequency-dispersive media to time-dependent electromagnetic waves. For the interesting cases of propagation through an absorbing region with an imposed longitudinal magnetic field, the transient response can be expressed directly in terms of the corresponding free-electron response; the free-election response being an infinite sum of scatters. The method is verified for general ionization profiles and specific solutions are found for the cases of a uniform and exponentially increasing ionization profile. Future research on this topic should involve extension to arbitrary polarization of incident waves and regions that are spatially inhomogeneous in two dimensions.
Publications:	"The Reflected Impulse Response of a Lorentz Medium" Proceedings of the IEEE, in press. "A convolution Method for Finding the Impulse Response of a Horizontally-Stratified Cold Plasma." Paper is in review status.

Title:	Radar Target Identification Via Time-Domain Scattering Signatures
Investigators:	Michael A. Morgan, Assistant Professor of Electrical Engineering and Michael Hamid, Professor of Electrical Engineering
Sponsor:	NPS Research Foundation Program
Objective:	To initiate a comprehensive program in inverse scattering research via both experimental and analytical efforts. The long-range goal is to identify and develop enhanced target recognition and classification schemes for future radar systems.
Summary:	This is a new project that is still in the start up phase. During the next year, our goal is to develop a new iterative inverse scattering method for radar target identification. A parallel effort will be the set up of a versatile time-domain scattering laboratory for use in both confirming and exercising the analytical approach, as well as in scale modeling radar returns from various targets of military significance. A practical demonstration of the method is our one-year benchmark objective.
Thesis Directed:	B. E. Welch, "Numerical Computation of Time-Domain Electromagnetic Scattering," (in progress) Master's Thesis, June, 1980.

Title: Sampled Analog Signal Processing

Investigator: T. F. Tao, Professor of Electrical Engineering

Sponsor: NPS Foundation Research Program

Objective: To develop theory, design procedure and applications of sampled analog recursive and nonrecursive filters using charge transfer devices. Also to investigate the limitations and sensitivities of sampled analog signal processing.

Summary: The investigation has concentrated in the area of nonrecursive filters for image processing applications, including the following: (i) The applications of sampled analog nonrecursive filters for image processing applications have been expanded to include both spatial and temporal filters designed by two optimization criteria for enhancing the target-to-clutter noise ratios including minimization of mean square error and maximization of target signal-to-clutter noise ratio. It was found that their design procedure and filter performance depends critically on the nature of targets of interest (unresolved point targets or resolved targets), background clutter (temporal and/or spatial correlation) and relative speed of target and frame time between successive frames of images; (ii) The design and performance of both statistical spatial and/or temporal filters have been investigated by using several real-world infrared images and yielded good background clutter suppression results; (iii) The design of experimental implementation of nonrecursive spatial/temporal filters using CTD Tapped Delay Line device controlled by a 16-bit microcomputer has been completed and partially fabricated; (iv) Since the sampled analog devices have relatively limited accuracy compared with digital processing devices, a sensitivity study was carried out to determine the deterioration of background clutter suppression performance of sampled analog nonrecursive filters of different degrees of

accuracy beyond two significant decimal numbers. This magnitude of accuracy required should be within the realm of possibility for sampled analog LSI devices. However, the accuracy requirements of other signal processing devices prior to the nonrecursive filter stage, may be more demanding than typically offered by sampled analog CTD devices. This aspect is being investigated.

Publication:

T. F. Tao, D. Hilmers, B. Evenor and D. BarYehoshua, "Focal Plane Processing Techniques for Background Clutter Suppression and Target Detection," Proceedings of the 1979 East Society of Photo-Optical Instrumentation Engineers, Vol. 178, "Smart Sensors," pp. 2-12, 1979.

Theses Directed:

D. C. Hilmers, "Spatial-Temporal Filters for Clutter Suppression and Target Detection of Real World Infrared Images," Engineer's Thesis, December, 1978.

K. P. Easterday, "Electronic Implementation of Spatial Filter Using Microcomputer Controlled CID Camera and CTD Tapped Delay Line, Master's Thesis, March, 1979.

K. Celik, "Focal Plane Signal Processing for Clutter Suppression and Target Detection in Infrared Images," Engineer's Thesis, June, 1979.

M. Koray, "Focal Plane Processing Techniques to Suppress Infrared Background Clutter, Detection and Tracking of Very Dim Targets Buried in Clutter Noise," Engineer's Thesis, June, 1979.

Title: Numerical Study of Tropical Large-Scale Ocean Atmosphere Coupling

Investigators: Chih-Pei Chang, Associate Professor of Meteorology and Ka Ming W. Lau, Professor of Meteorology

Sponsor: NPS Foundation Research Program

Summary: This research is aimed at studying the effects of interactions between the tropical atmosphere and ocean on the long-term variabilities of the coupled system. A large-scale air-sea coupled model has been developed to investigate specifically the climatic feedback mechanisms between the Hadley and Walker-type low-latitude circulations in relation to mixed-layer and advective processes in the ocean. Results indicate a negative feedback existing between the strength of the Hadley circulation and the ocean-mixed layer temperature, such that over the equatorial eastern Pacific, an anomalous increase in the trade winds is always opposed by the concomitant cooling of the sea-surface temperature due to upwelling below the seasonal thermocline. Further results indicate that a positive feedback in the form of interactions between low-frequency atmospheric and oceanic Kelyin waves may exist in the equatorial coupled system.

Publications:

Ka Ming W. Lau, 1979: A numerical study of tropical large-scale air-sea interactions, Journal of Atmospheric Sciences, 36, 1467 - 1489.

_____, 1979: Climate feedback mechanisms in the equatorial Pacific, The GARP Programme on numerical experimentation.

_____, 1979: Large-scale coupled oscillations in a simple equatorial ocean-atmosphere system, to appear in Ocean Modelling.

_____, 1979: Oscillations in a simple equatorial climate system. Part I: An Analytical study, submitted to Journal of Atmospheric Sciences.

_____, 1979: Oscillations in a simple equatorial climate system. Part II: A numerical study, submitted to Journal of Atmospheric Sciences.

Conference Presentations:

Ka Ming W. Lau: A numerical study of tropical large-scale air-sea interaction, presented at Third Conference on Ocean-Atmosphere Interaction, Los Angeles, California, 30 January - 1 February 1980.

Title: Numerical Models of Ocean Circulation and Climate Interaction--A Review

Investigator: Robert L. Haney, Associate Professor of Meteorology

Sponsor: NPS Research Foundation Program

Objective: To research and review the open literature and prepare a review article for inclusion in a United States Quadrennial Report to the International Union of Geodesy and Geophysics.

Summary: From a survey of the recent literature, it was found that considerable progress was made in modeling the ocean circulation and climate interactions during the last four-years. In summary, the most significant advances include an increased understanding of the sensitivity of the atmosphere to large-scale anomalies of sea surface temperature in both middle and equatorial latitudes; the establishment of a new theory for the fomation of El Nino involving equatorial Kelvin waves; the discovery, suggested by a comparison of fine-resolution model studies and ocean data, that mid-ocean eddies are driven by energy exported from regions of intense currents; and the discovery of a large oceanic seasonal heat transport from the summer hemisphere to the winter hemisphere and a possible explanation for it in terms of Ekman pumping suggested by numerical model simulations. Future progress is needed in understanding the role of mesoscale rings and eddies in maintaining the oceanic general circulation and the oceanic poleward heat flux; in developing methods of parameterizing their effects in ocean circulation models; in coupling realistic ocean mixed layer models to ocean circulation models dedicated to climate; and numerical simulations of the interannual variability of the coupled ocean atmosphere system should be made in more complete models and the role of the ocean in producing that variability determined.

Publication: Haney, R. L., "Numerical Models of Ocean Circulation and Climate Interaction," Rev. Geophy. Space Physics, 1979 (in press).

Title:	Applications of Model Output Statistics to Forecasting Operationally Important Air/ Ocean Parameters
Investigators:	R. J. Renard, Professor of Meteorology and W. van der Bijl, Associate Professor of Meteorology
Sponsor:	NPS Foundation Research Program
Objective:	Improvement of marine visibility forecasting (short-term). Prediction of cloud heights/ amount and near-surface winds (long-term).
Summary:	The study represents the initial development of a model output statistics scheme to specify the probability of each of several ranges of visibility over the open ocean, using stepwise multiple linear regression. The probabilities are further manipulated to yield categorical visibility estimates. Predictors are chosen from available Fleet Numerical Oceanography Center's output parameters, with sensible and evaporative heat fluxes, relative humidity, sea level pressure and meridional wind speed contributing most to explaining the variance of visibility predictand. The dependent tests, still in the diagnostic stage, are being carried out for the North Pacific Ocean summer season with verification scores indicating considerable promise for the scheme.
Thesis Directed:	LT W. T. Aldinger, "Experiments on Estimating Open Ocean Visibilities Using Model Output Statistics." Master's Thesis, December, 1979.

Title: Parameterization of Water Vapor Effects on the Refractive Index Structure Function Parameter, C_N^2.

Investigators: Gordon E. Schacher, Associate Professor of Physics and Chemistry and Kenneth L. Davidson, Associate Professor of Meteorology

Sponsor: NPS Research Foundation Program

Objective: Determine the influence of humidity flucuations on the optical structure function in the marine atmospheric surface layer.

Summary: Atmospheric turbulence measurements, including temperature and humidity fluctuations, were made from the R/V ACANIA, off the coast of California in June, 1979. The purpose of the experiment was to investigate the scaling properties of the humidity structure function parameter (C_q^2) and temperature-humidity co-spectrum structure function parameter (C_{Tq}) in the marine surface layer. The bulk parameterization method was used to obtain Monin-Obukhov Similarity (MOS) scaling parameters u_*, T_*, $q_*$and L. Assuming a neutral stability humidity drag coefficient $c_{qn} = 1.3 \times 10^{-3}$, the dimensionaless humidity structure function parameter $C_q^2 z^{2/3}/q_*$ was found to be 18% lower than the corresponding temperature function obtained by Wyngaard, et al, (1971). Furthermore, the measurements indicate that temperature-humidity fluctuations are highly coherent well into the inertial subrange. The results have direct application to turbulent scattering of waves propagating in the atmosphere (particularly microwaves) and methods of estimating air-sea surface fluxes.

Publications: C. W. Fairall, G. E. Schacher and K. L. Davidson, "Measurements of the Humidity Structure Function Parameters, C_q^2 and C_{Tq} over the Ocean," Boundary Layer Meteorology, accepted for publication.

Title:	Response of Moving Atmospheric Front Changes in Environmental Conditions
Investigator:	R. T. Williams, Professor of Meteorology
Sponsor:	NPS Research Foundation Program
Objectives:	The objective of the research is to determine the modifications in frontal structure, which occur when an atmospheric front moves over a surface whose temperature and moisture properties are changing.
Summary:	This research is based on the primitive equation model which was developed by Cornelius, Glevy and Williams (1975) for a steady state front with condensation. The finite difference scheme was changed to a spatially staggered form that was designed to reduce the numerical noise in the solution. A coordinate transformation was made that allowed the front to move to a fixed speed respect to the ground. The numerical solutions with condensation heating were much smoother than in the previous study. The coordinate transformation led to steady-state solutions in the moving coordinate system and the frontal structure was compared with nonmoving cases. This research will be continued during FY80 by applying the model to various conditions observed in the early summer monsoon trough over eastern Asia.
Publication:	"Effects of Latent Heat of Condensation and Surface Propagation on Steady State Fronts," in preparation.

Title:	Aerodynamic Stabilization of Gaseous Discharges
Investigators:	Oscar Biblarz, Associate Professor of Aeronautics, J. Stricker, Adjunct Research Professor of Aeronautics
Sponsor:	NPS Foundation Research Program
Objectives:	The main objective is to define practical aerodynamic means for stabilizing discharges of interest for electrical lasers and other applications. A particular objective was to test the effects of intense, low-frequency turbulence on the discharge and to consider a design for transient laser-discharge experiments. This is part of a continuing program.
Summary:	Turbulence generated in the mixing region of the main flow with an auxiliary oscillating flow has been tested. The first oscillator-flow unit has been found somewhat lacking and a second one is under consideration. Also, a Ludwieg tube design has been outlined for the eventual testing of laser mixtures.
Publications:	Y. Khait and O. Biblarz, "Influence of Turbulence on a Diffuse Electrical Gas Discharge Under Moderate Pressures," JAP, 50, 4692 (1979). J. Stricker, "Design Considerations of a Flow System for Transient Laser Discharge Experiments," NPS Report NPS 67-79-008, August, 1979.

Title:	A Basic Reformulation of the Pipe Flow Stability Program
Investigator:	T. H. Gawain, Professor of Aeronautics
Sponsor:	NPS Foundation Research Program
Objective:	To reformulate the classical unsolved problem of the hydrodynamic stability of pipe flow in such a way as to obtain an analytical and numerical solution which finally accounts for the experimentally observed facts.
Summary:	The present analysis has revealed that the boundary conditions at the axis of the pipe have a complexity which has hitherto been unsuspected. These complex boundary conditions have now been reformulated in a completely general and rigorous fashion thus completing the analytical solution. Extensive numerical calculations still remain to be carried out. The results of these calculations should finally prove or disprove the new theory.
Publications:	A technical report is in preparation which summarizes theoretical developments up to this time. Publication of technical papers will be held in abeyance, however, until forthcoming numerical work reveals decisive results, probably in 1980.

Title:	Heat Transfer from a Cylinder Immersed in an Oscillating Free Stream Flow
Investigator:	J. A. Miller, Associate Professor of Aeronautics
Sponsor:	NPS Foundation Research Program
Objective:	To calibrate the platinum resistance thermometer-heaters in a four-inch heat transfer model and obtain heat transfer data in steady flow to validate instrumentation.
Summary:	Calibration of the 16 platinum resistance thermometer-heaters was carried out in an isothermal bath from 60°F to 180°F. Steady flow heat transfer measurements were made at four Reynolds numbers: 1.76×10^5; 2.4×10^5; 3.5×10^5 and 4.9×10^5. Resultant data have been compared with the steady flow results of Seban (1960) and Achenbach (1975) showing excellent agreement. Preliminary oscillating flow runs have been made at oscillation frequencies of 21, 60 and 100 Hz indicating that an important separation effect is encountered between 21 and 60 Hz. During these latter runs, the model was inadvertently overheated and some delamination resulted. This has now been corrected employing specially formulated high temperature bonding materials.
Publications:	A paper reporting the results of the oscillating flow heat transfer measurements will be submitted to The Journal of Heat Transfer when these measurements have been completed.
Thesis Directed:	The work to-date has served as a special project (AE 3815) for LT D. A. Duval. It is expected that the remainder of the investigation will serve as a thesis project.

Title:	Holographic Study of Solid Propellant Combustion
Investigator:	David W. Netzer, Associate Professor of Aeronautics
Sponsor:	NPS Foundation Research Program
Objective:	To obtain high resolution holograms of Al/Al_2O_3 agglomerates within the propellant grain of a two-dimensional solid rocket motor in order to assess the effects of propellant properties and operating environment on two-phase flow losses.
Summary:	This program was initiated in September, 1979. As of 30 November 1979, the following progress has been made. The two-dimensional slad motor has been designed and required materials ordered; and an initial holographic set-up has been made and laser checkout/ repair initiated.

Title:	Multi-Stage Compressor Study
Investigator:	R. P. Shreeve, Associate Professor of Aeronautics and Dipl. Ing. Hans Zebner, Aachen, West Germany
Sponsor:	NPS Foundation Research Program
Objective:	To reblade and instrument a large three-stage axial compressor to facilitate a wide range of compressor experiments, including the study of tip clearance effects.
Summary:	A method of casting blading from epoxy resin was developed earlier in-house. Since the cast blades do not have to be machined, different blading designs can be built and evaluated inexpensively. New blading of moderate loading was designed and cast for three stages of a 36-inch O.D. compressor. The blades are 7.2 inches long and arranged in a straight annulus. A procedure to finish the blade tips and to set the individual blade angles to uniform accuracy was devised and the necessary jig was designed and built. A data acquisition system which uses a stand-alone Hewlett-Packard System 45 with a Scanivalve interface developed in-house, was procured. Installation of the blading is proceeding.

Title: Acoustic Variability Experiment

Investigators: E. B. Thornton, Associate Professor of Oceanography and T. P. Stanton, Adjunct Professor of Oceanography and W. W. Denner, Associate Professor of Oceanography

Sponsor: NPS Foundation Research Program

Objective: Investigation of the phase and amplitude modulation of sound propagating through the upper layers of the ocean.

Summary: A successful experiment was conducted 2 - 26 August, 1979. Acoustic amplitude and phase fluctuations were measured across a 400 meter path. The sound source and hydrophones were mounted on the shelf adjacent to the Carmel Canyon at a depth of 35 meters. The depth of the canyon at this location is approximately 180 meters. The experiment was designed to measure only the direct path of sound and not receive either the surface or bottom reflected sound. The acoustic source signal was a composite pulse consisting of a 0.5 millisecond 20 kHz pulse followed by 5 milliseconds of pseudo-random noise. The pseudo-random noise has acoustic energy in the band from 1 to 20 kHz.

The ocean temperature structure was measured both at the source and the receivers using horizontal and vertical thermistor arrays in order to determine the structure and correlation functions for the temperature microstructure. A two current meter array measured the current shear; thermistors are also mounted on the current meter packages to give long time series of the temperature. Analysis of the approximately 200 megabytes is in progress.

Publication: Denner, W. W., E. B. Thornton, T. P. Stanton, "Acoustic Variability and Air Sea Transfer," presented at MORS Conference, December 5, 1978, Naval War College, Newport, Rhode Island.

Thesis: Christensen, C., "Temperature Microstructure Profiles in Monterey Bay," Master's Thesis, December, 1978.

Title:	Evaluation of the Mechanical Behavior of Materials and Coatings
Investigator:	Donald H. Boone, Adjunct Research Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	To evaluate the mechanical behavior of materials and coatings in aerospace type environments and conditions. A research program was established to evaluate the effects of processing and microstructure on the fatigue behavior of high strength AISI 52100 steel used in gas turbine bearings.
Summary:	Suitable materials were obtained, processed and characterized prior to testing in a modified room temperature cantilever bend fatigue machine, modified under Foundation support. Results of a study of structural and processing effects showed significant improvements in low cycle fatigue and endurance limits. Results are documented in the thesis listed below. Additional material is being used in a continuing microstructural and fracture toughness evaluation program.
Thesis Directed:	Chung, LCDR Ik Sik, ROK, "Fatigue Behavior of Ultra-High Carbon Steels," Master's Thesis, December, 1979.

Title:	Investigation of the Flow in the Rectilinear Cascade using Hot Wire Anemometry and Liquid Crystal Thermography
Investigator:	Matthew D. Kelleher, Associate Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	Develop and implement experimental techniques for studying the fluid mechanics in the NPS rectilinear cascade. The techniques to be investigated are: 1) Hot wire anemometry to measure the velocity distribution and turbulence characteristics of the flow; and 2) Liquid crystal thermography for the visualization of surface characteristics of the flow over blading.
Summary:	Using hot wire anemometry, a base line turbulence intensity level has been determined for the rectilinear cascade at the NPS Turbopropulsion Laboratory. The turbulence with straight inlet guide vanes has been compared to the turbulence without guide vanes. Results indicate a uniform though slightly greater turbulence level when using guide vanes. The use of liquid crystal thermography is being investigated as a technique for visualizing the flow over cascade test blades. Methods of applying the crystals and methods of resistance heating the blade surface have been investigated.
Publications:	A research report is being prepared.
Thesis Directed:	W. R. Miller, "Hot Wire Anemometer Investigation of Turbulence Levels and Development of Liquid Crystal Flow Visualization Techniques for the Rectilinear Cascade Test Facility," Master's Thesis, September, 1979.

APPENDIX I

Summary Title	Investigator	Type Funding
COMPUTER SCIENCE		
A Microprocessor Based Secure Archival Storage System	L. A. Cox R. R. Schell	6.2
A Decision Support System Model for Technology Transfer	R. J. Roland	6.1
MATHEMATICS		
Comparison of Methods for Approximation of Surfaces by Interpolation at Scattered Data Points	R. Franke	6.1
Convergence of the Conjugate Gram Schmidt Method	I. B. Russak	6.1
Workshop on Applied Mathematics	A. L. Schoenstadt C. Comstock	6.1
ADMINISTRATIVE SCIENCES		
An Analysis of the Relationship of Performance to Perceived Control over Budget Measures Used for Evaluative Purposes	K. J. Euske	6.1
Computer System Conversions: Estimating Costs and Regulatory Effects	C. R. Jones P. Ein-Dor	6.1
Application of the Log-normal Distribution to Corrective Maintenance Downtimes	M. B. Kline R. Almog	6.1
Estimating Probabilities for Cost Variance Investigation Decisions: A Bayesian Approach	S. S. Liao	6.1

Summary Title	Investigator	Type Funding
ADMINISTRATIVE SCIENCES, cont.		
The First Years Out Study--Career Transitions: Facilitating Recruit Adaptation	M. R. Louis	6.1
An Approach to Demand Theory Under Uncertainty	G. Thomas	6.1
OPERATIONS RESEARCH		
Enhancements to LLRANDOM II Random Number Generation Package	P. A. W. Lewis	6.2
Quantitative Analysis of Air-War Strategies for Use in Air-Armaments Planning	J. G. Taylor R. K. Huber	6.1
Minimum Delay Routing of C^3 Computer Networks Using Adaptive Distributed Algorithms	J. Y. Yen	6.1
NATIONAL SECURITY AFFAIRS		
Communist Countries and Africa	J. Valenta	6.1
The USSR, Cuba and Africa	J. Valenta	6.1
The USSR and the Somalian-Ethiopian Conflict	J. Valenta	6.1
PHYSICS AND CHEMISTRY		
Investigation of the LINAC Electron Beam as a Source of Coherent Electromagnetic Radiation	F. R. Buskirk	6.1
Nuclear Giant Multipole Resonances by Inelastic Electron Scattering	F. R. Buskirk J. N. Dyer R. Pitthan	6.1
Classical Trajectory Studies of Low Energy Ion Impact Mechanisms on Clean and Reacted Single Crystal Surfaces	D. E. Harrison B. J. Garrison N. Winograd	6.1

Summary Title	Investigator	Type Funding
PHYSICS AND CHEMISTRY, cont.		
Spectroscopic Data Center Compilation of Atomic Energy Levels	R. L. Kelly	6.1
Forward Scatter from a Randomly Rough Surface	H. Medwin	6.1
Laser Induced Acoustic Pulses in Water	F. Schwirzke	6.1
Time Development of Laser Produced Plasmas	F. Schwirzke	6.1
ELECTRICAL ENGINEERING		
Alternative Seafarer Antennas	O. M. Baycura	6.1
Investigation of Transient EM Waves in Frequency-Dispersive Media by a Multiple-Scattering Method	K. G. Gray	6.2
Radar Target Identification Via Time-Domain Scattering Signatures	M. A. Morgan M. Hamid	6.1
Sampled Analog Signal Processing	T. F. Tao	6.1
METEOROLOGY		
Numerical Study of Tropical Large-Scale Ocean Atmosphere Coupling	C. P. Chang K. M. W. Lau	6.1
Numerical Models of Ocean Circulation and Climate Interaction--A Review	R. L. Haney	6.1
Applications of Model Output Statistics to Forecasting Operationally Important Air/Ocean Parameters	R. J. Renard W. van der Bijl	6.2
Parameterization of Water Vapor Effects on the Refractive Index Structure Function Parameter, C_N^2.	G. E. Schacher K. L. Davidson	6.1

Summary Title	Investigator	Type Funding
METEOROLOGY, cont.		
Response of Moving Atmospheric Front Changes in Environmental Conditions	R. T. Williams	6.1
AERONAUTICS		
Aerodynamic Stabilization of Gaseous Discharges	O. Biblarz J. Stricker	6.1
A Basic Reformulation of the Pipe Flow Stability Program	T. H. Gawain	6.1
Heat Transfer from a Cylinder Immersed in an Oscillating Free Stream Flow	J. A. Miller	6.1
Holographic Study of Solid Propellant Combustion	D. W. Netzer	6.2
Multi-Stage Compressor Study	R. P. Shreeve H. Zebner	6.2
OCEANOGRAPHY		
Acoustic Variability Experiment	E. B. Thornton T. P. Stanton W. W. Denner	6.2
MECHANICAL ENGINEERING		
Evaluation of the Mechanical Behavior of Materials and Coatings	D. H. Boone	6.2
Investigation of the Flow in the Rectilinear Cascade using Hot Wire Anemometry and Liquid Crystal Thermography	M. D. Kelleher	6.1

PROGRAM REVIEW

The Foundation Research Program is monitored by the Pasadena Branch Office of the Office of Naval Research

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